The *SMOS* MISSION: Present Status and Future Plans

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ABSTRACT

It is now well understood that soil moisture and sea surface salinity are required to improve meteorological and climatic predictions. These two quantities are not yet available globally and with an adequate temporal sampling. So as to cover this data gap, it has been recognized that, provided it is possible to accommodate a suitable antenna on board a satellite, L Band radiometry was most probably the most promising way to fulfill this gap .

It is within this framework that the European Space Agency (ESA)'s selected the second Earth Explorer Opportunity Mission, namely the Soil Moisture and Ocean Salinity (*SMOS*) mission. The *SMOS* mission a joint program lead by ESA with the CNES in France and the CDTI in Spain.

***SMOS* carries a single payload, an L band 2D interferometric radiometer in the 1400-1427 Mhz protected band. This wavelength penetrates well through the vegetation and the atmosphere is almost transparent.**
Consequently, the instrument probes the Earth surface emissivity. Surface emissivity can then
be related to the moisture content in the first few centimeters of soil over land, and, after some surface roughness and temperature corrections, spatio temporal aggregation, to the sea surface salinity over oceans.

CONTEXT

Soil Moisture and Ocean Salinity are key geophysical parameters ruling surface – atmosphere interactions

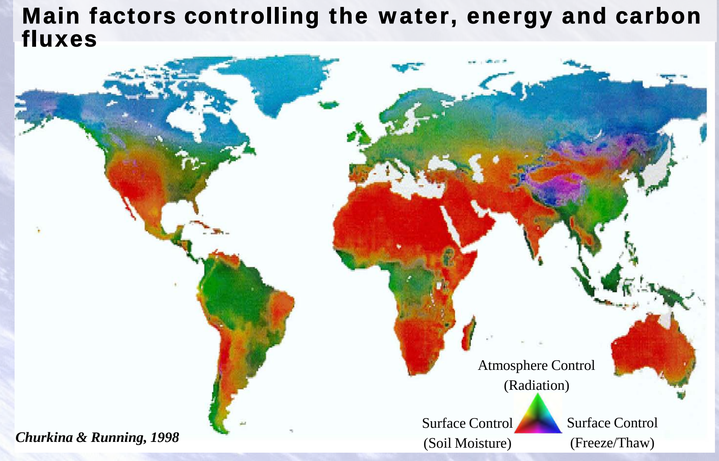
SM rules :
- storage of water (surface and root zone)
- water uptake by vegetation (root zone)
- fluxes at the interface (evaporation)
- influence on run-off

OS rules :
- Thermohaline overturning circulation
- Air-sea freshwater budget.
- Tropical ocean and climate feedback

SM – OS Imply relevance for
-Weather Forecasts
- Climatic studies
- Water resources
- crop management
- Forecast of extreme events

Climate change predictions and rain event forecasts require ....*SMOS* !!!!!

Main factors controlling the water, energy and carbon fluxes

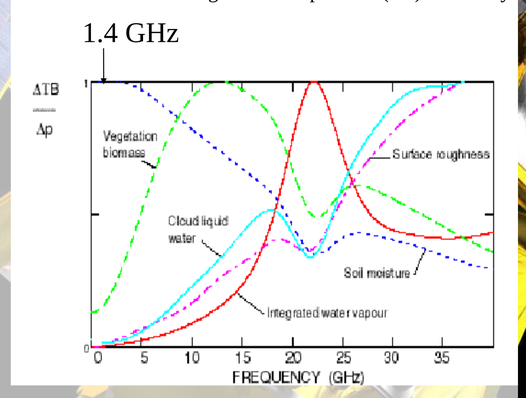


Churkina & Running, 1998

How to access soil moisture ?

- Ground measurements
- Networks (GEWEX)
- SW, SWIR, ...
- THIR....
- Low frequency microwaves
  - Active microwaves
    - Vegetation, roughness
    - Revisit
    - Sensitivity

Passive Microwave Brightness Temperature (TB) sensitivity

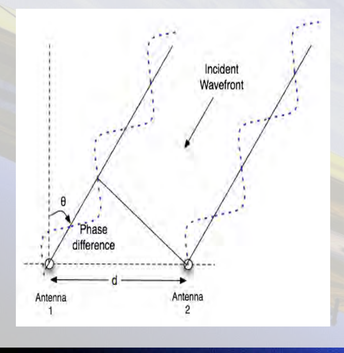


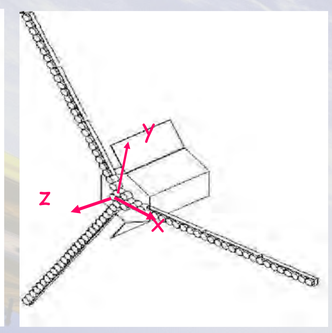
L-band 1.4GHz (21 cm) :
Sensitive to surface soil moisture. Most of the time, soil moisture of the first centimeters, deeper in case of dry sand

– **Passive microwaves, antenna issue overpassed by** interferometry
Frequency = 1.4 Ghz : sensible to soil moisture and less to other contributions

Interferometry principle

Interferometry measures the phase difference between electromagnetic waves at two or more receivers. As long as the observed phase difference can be related to waves emitted at the same time, the origin of the wave can be determined. If the difference in time needed by the waves to travel from the ground to the receivers is greater than one wavelength, then observations of the phase difference are ambiguous.
This so-called 'aliasing' effect limits the usable swath of the observations made by *SMOS*.
=> star-shaped of a snapshot





Main Features

- 2D passive interferometric radiometer
  Y-shaped 3 arms synthetic aperture antenna.

- Orbit : sun-synchronous polar
  altitude : 763 km

- equator crossing time : twice per day
  ~06h00, ascending phase
  ~18h00, descending phase

- full scene every 2.4s (dual or full polarisation)

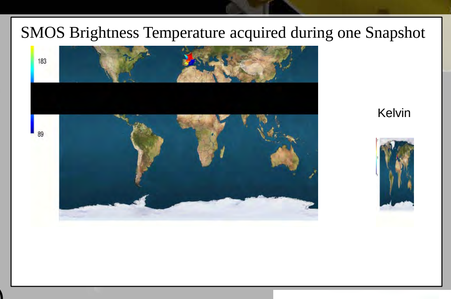
- Average resolution : 43 km, global coverage

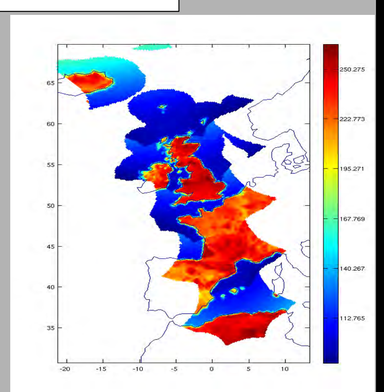
- Multi-angular

-Maximum time (equator) between acquisitions : 3 days (Asc or Desc).

- Accuracy :
  Soil Moisture : 4% vol.
  Ocean Salinity : 0.1 PSU

SMOS Brightness Temperature acquired during one Snapshot





CURRENT ACTIVITIES

- ground experiments
- modeling activities
- simulations and generation of synthetic data sets for assessing retrieval algorithms (using existing sensors)
- large field campaigns either on the long time scale or over specific targets to address the specific issues related to retrieval with multi-angular L band measurements.
- Intensive efforts devoted to the basics of interferometry : optimization of image reconstruction, devising the most efficient calibration scheme
- External but important issues such as Galactic contribution, Sun's emission variation monitoring or radio frequency interferences.

Calibration Validation

development of large databases : soil moisture, brightness temperature, Meteorological measurements

SMOSREX : Arnaud Mialon (CESBIO)
Experiment site near Toulouse, France.
Mutli-angular L-band measurements over bare soil and fallow.
Surface modeling

AMMA : Patricia de Rosnay (ECMWF)
Multiscale validation of *SMOS* brightness temperature and products over West Africa

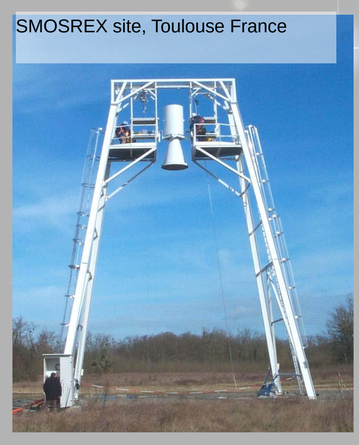
National Airborne Field Experiment (NAFE) : PI : Gilles Boulet (CESBIO/IRD)
Use a combination of airborne L-band brightness temperature, NDVI and surface temperature data and distributed in-situ soil moisture data acquired at the scale of several *SMOS* pixels during two field experiments in SE Australia

Calibration of *SMOS* products Geolocalisation Biases, PI : Francois Cabot (CESBIO/CNES)
The aim of this study is to deliver a full characterization of on-orbit geolocalisation biases as observables in *SMOS* products.

Valencia Anchor Site (S Juglea CESBIO) E Lopez Baeza (UoV)
Prepare a ground point match up for *SMOS* validation

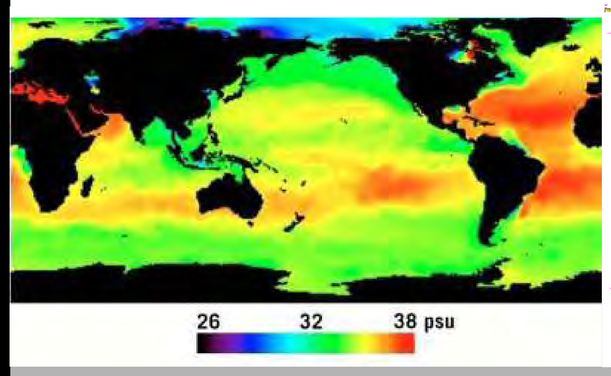
***SMOS* MANIA (JC Calvert CNRM)**
Generate a large area (SW France) with several ground control points and a spatialisation of measurements with

SMOSREX site, Toulouse France

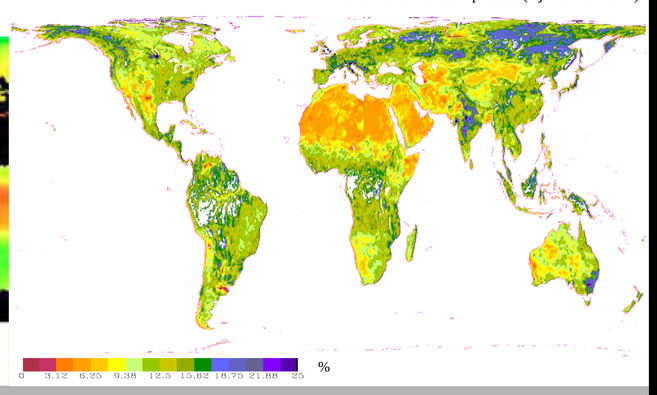


SMOS Products

Ocean salinity simulated by models.



AMSR Soil Moisture product (Njoku et al. 2004)



Control, Mission and Data Centers

The *SMOS* Satellite Control Centre will be adapted by CNES from generic PROTEUS ground segment and installed in Toulouse within the CNES premises. A *SMOS* Mission Centre dedicated to level 1 and 2 products, is being developed and located in the ESA / Villafranca centre. A specific Data Processing Centre dedicated to level 3 and 4 products * is being developed by CNES.

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please visit http://www.cesbio.ups-tlse.fr/fr/indexsmos.html